Center Independent Research & Development: GSFC IRAD

Polarization Characterization of a Multi-Moded Feed Structure

Completed Technology Project (2012 - 2015)

Project Introduction

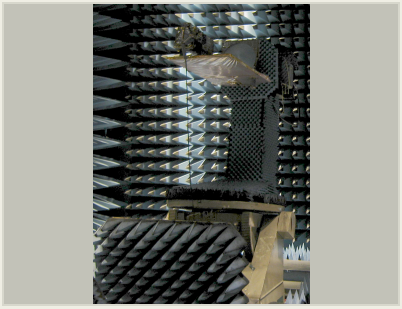
The Polarization Characterization of a Multi-Moded Feed Structure projects characterize the polarization response of a multi-moded feed horn as an innovative approach to polarized measurements in the far-infrared. Multi-moded optics provide a significant increase in instrument sensitivity per detector, but the polarization response of such quasi-optical structures is not well understood. We will measure the co-polar and cross-polar beam patterns of a multi-moded feed horn.

A simple, focused investigation will measure the co-polar and cross-polar response of a multi-moded feed. We will fabricate a larger version of a far-IR feed, mount it within the Goddard Electromagnetic Anechoic Chamber (GEMAC), and measure the co-polar and cross-polar response using wire grid polarizers mounted at the source and multi-mode detector.

The polarization response of a multi-moded feed is difficult to model. Geometric optics (ray tracing) yields the response in the high-frequency (short wavelength) limit, but ignores effects of beam diffraction at the edges of the feed. Solution of Maxwell's equations within the feed structure provides an analytic expansion of the response using waveguide theory, but is computationally tractable only in the few-mode (long wavelength) regime. Astrophysical signals in the far-infrared (e.g. the cosmic microwave background) are bright at frequencies near 300 GHz (1 mm wavelength), squarely between the two limits. Diffraction is important at these wavelengths, yet tens to hundreds of electromagnetic modes propagate within the feed structure, making direct calculation extremely difficult. Measurements of a first-generation feed horn demonstrate basic functionalit and provide a simple model to guid future design. Based on the initial results, we plan to design and test a second-generation feed to maximize throughput while minimizing the cross-polar response.

Anticipated Benefits

N/A



Prototype feed horn undergoing beam pattern measurements

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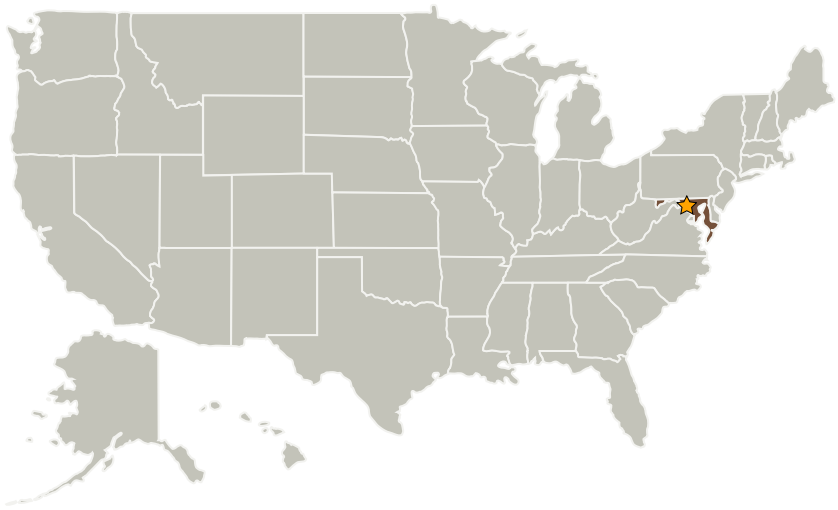
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2012: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

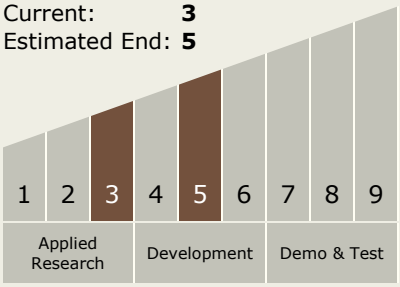
Stanley D Hunter

Principal Investigator:

Alan J Kogut

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **5**



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September 2015: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Images

Prototype feed horn
Prototype feed horn undergoing beam pattern measurements *(https://techport.nasa.gov/image/36912)*

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

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Links

GSC-16319-1
(https://ntts.arc.nasa.gov/app/)

Polarization Properties of a Multi-Moded Feed Horn for the Primordial Inflation Explorer Mission
(http://adsabs.harvard.edu/abs/2014SPIE.9153E..18K)

Project Website:

http://sciences.gsfc.nasa.gov/sed/